960,488

PATENT SPECIFICATION

DRAWINGS ATTACHED

960,488

Inventors: JAMES EDWARD TRAINER
and WALTER FRANKLIN BISHOP

Date of Application and filing Complete Specification: Nov. 27, 1961.

No. 42291/61.

Complete Specification Published: June 10, 1964.

Index at acceptance:—D1 K22

International Classification:—D 04 j

COMPLETE SPECIFICATION

Method and apparatus for producing Rubberized Tire Fabric

We, THE FIRESTONE TIRE & RUBBER COMPANY, a corporation organized under the laws of the State of Ohio, United States of America, of 1200 Firestone Parkway, Akron 17, State of Ohio, United States of America, do hereby declare the invention, for which [illegible] to us.

creels of wire. Such a plurality of creels take up a great deal of operating space on the factory floor and presents a tremendous inventory space and cost problem. Further each time a different type of fabric is to be run through the calender, each cord, of the hundreds required, must be individually [illegible]ime-and-

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and with the cords of the fabric at some angle between 0° and 90° to the axis of rotation of the tire building drum. The fabric on the tire-building drum is said to be bias-cut.

Under some conditions, the fabric to be calendered will contain no transverse threads holding the longitudinally extending cords together; such is generally the case with wire tire fabric. Here, each individual cord is taken off its own creel and led to the calender rolls through comb-like separators which maintain the cords at a constant spacing while they are being rubberized.

Clearly, a fabric web of this type, comprised of hundreds of individual cords, will thus require the use of an equal number of

The invention also provides apparatus for producing tire fabric, which comprises means for aligning a plurality of cords in parallel relationship, means to draw said aligned cords through a rubber extruder into rubberized tape form, characterized by a rotatable winding member, a winding carriage adapted for travel parallel to the axis of rotation of said member, applicator means on said carriage to lay said tape on said member, and means for rotating said member and for advancing said carriage in timed relationship to produce a helical wind of said tape on said member.

The invention thus makes it possible to reduce the inventory of cord reels necessary,

[*Price 4s. 6d.*]

ERRATUM

SPECIFICATION No. 960,488

Page 1, Index of Acceptance, *for* "D1 K22" *read* "D1 KA22"

THE PATENT OFFICE
6th July, 1964

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We, THE FIRESTONE TIRE & RUBBER COMPANY, a corporation organized under the laws of the State of Ohio, United States of America, of 1200 Firestone Parkway, Akron 17, State of Ohio, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the production of rubberized tire fabric, and more particularly to a method and apparatus for producing tire fabric from a tape of rubberized cords.

In the production of tires, tire fabric is presently produced in the following manner:

An unvulcanized rubbery composition is calendered onto both sides of a wide, longitudinally extending fabric web comprising a plurality of parallel cords; this width of fabric is then cut into trapezoidal sections, turned, and joined longitudinally. In this manner, the cut edges now form the sides of the new fabric web, which is then supplied to the building drum. Portions of this web are in turn laid on the building drum with the longitudinal fabric edges parallel to the ends of the drum, and with the cords of the fabric at some angle between 0° and 90° to the axis of rotation of the tire building drum. The fabric on the tire-building drum is said to be bias-cut.

Under some conditions, the fabric to be calendered will contain no transverse threads holding the longitudinally extending cords together; such is generally the case with wire tire fabric. Here, each individual cord is taken off its own creel and led to the calender rolls through comb-like separators which maintain the cords at a constant spacing while they are being rubberized.

Clearly, a fabric web of this type, comprised of hundreds of individual cords, will thus require the use of an equal number of creels of wire. Such a plurality of creels take up a great deal of operating space on the factory floor and presents a tremendous inventory space and cost problem. Further each time a different type of fabric is to be run through the calender, each cord, of the hundreds required, must be individually threaded through the separators, a time-and-labor consuming operation.

The creel-method of fabric production is thus hampered by problems of storage cost and space, factory operating space, flexibility of change-over and by excessive time and labor required.

The present invention solves these problems by producing, through use of a minimum number of stations, the trapezoidal sections of rubberized cord, which are turned and then readied for the tire building operation.

In accordance with the present invention there is provided a method of producing tire fabric, which comprises enclosing a plurality of cords in a rubbery compound, forming said cords and compound into a longitudinally extending tape, winding said tape helically into a fabric envelope, and opening said envelope along a line extending at an angle to said cords to form a trapezoidal sheet.

The invention also provides apparatus for producing tire fabric, which comprises means for aligning a plurality of cords in parallel relationship, means to draw said aligned cords through a rubber extruder into rubberized tape form, characterized by a rotatable winding member, a winding carriage adapted for travel parallel to the axis of rotation of said member, applicator means on said carriage to lay said tape on said member, and means for rotating said member and for advancing said carriage in timed relationship to produce a helical wind of said tape on said member.

The invention thus makes it possible to reduce the inventory of cord reels necessary,

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and to economize on the factory space required for production of fabric.

The invention also permits rapid change-over between different types of cord and rubbery stocks, with a minimum of shut-down time.

The method and apparatus of the present invention may be used advantageously in lieu of present operations using creel cord in the forming of tire fabric. The present invention is thus useful whether the cords comprise extensible or inextensible material; and is advantageous whether the cord is monofilamentary or stranded and twisted.

Although not limited thereto, the present invention will be described and discussed in connection with the production of tire fabric from inextensible wire cord.

The present invention will now be described in greater detail with reference to the accompanying drawings in which:

Figure 1 is a fragmentary, perspective, sectional view showing one form of tape used in accordance with the invention;

Figure 2 is a view similar to Figure 1 showing a modified form of tape;

Figure 3 is a somewhat diagrammatic view of the apparatus for forming tire fabric in accordance with the invention;

Figure 4 is an end view of the winding member of Figure 3;

Figure 5 is a plan view of the apparatus of Figure 4 showing the start of the winding operation;

Figure 6 is a view similar to Figure 5 showing the end of the winding operation;

Figure 7 is a view similar to Figure 6 showing the fabric envelope prior to removal from the winding member;

Figures 8, 9, & 10 are diagrammatic views showing the progressive steps of forming a continuous web of tire fabric after the winding operation; and,

Figure 11 is a fragmentary sectional view showing a modification of the tire fabric of the invention.

The process of the invention commences with the production of a tape, whereby is understood a continuous member comprising cord and a tacky, unvulcanized insulation material, such as a rubbery compound. This tape may comprise a single rubberized cord, or a plurality of spaced parallel cords joined together in a rubbery compound to form a tape of a width substantially greater than the thickness thereof. The width of the tape useful for the purposes of this invention will be determined to some extent by factors to be discussed hereinafter.

The tape can be produced by several different methods. For example, a plurality of parallel wires may be extruded through a die along with a rubbery compound. This method of forming a continuous tape was found to be particularly advantageous in the practice of the invention.

Acceptable tape may also be produced by the calendering method. Here, straight grooved rolls will also form a flat tape, such as that shown in Figure 1; shaped rolls will form a tape similar to that shown in Figure 2.

Whether the tape is formed by extrusion, by calendering or by some other method, the completed tape may be stored for later application to the rotatable winding member, or may preferably be led directly thereto for immediate application and forming into a band or envelope.

The application of the tape to the rotatable winding member takes place through a guide-and-applicator-means which travels along the face thereof in a path parallel to the axis of rotation, to lay a helical wind of tape.

The winding member and the carriage move in timed relationship; the winding member rotates at a speed related to the applicator's speed and to the width of the tape in such a manner that the edges of the tape convolutions come together to form an envelope having a continuous surface.

The extruded width of tape may be made slightly greater than the pitch of the tape as applied to the winding member. In this manner, there is produced a slight interference between the edges of adjacent convolutions of the tape, thereby providing a firmer bond between the edges.

For example, where the pitch of the helix (the tape advance per revolution) is 10/14", a slight interference can be produced by using a tape width of 21/28". It is not necessary, of course, to have as great an interference. Indeed, it is preferable to have no interference at all, making the width of the tape exactly equal to the pitch, so that an exact abutment of the adjoining convolutions is performed.

In the form of the invention in which the tape is produced by extruding the wire and rubber together at a location immediately adjacent to the winding operation, there will be an obvious advantage derived from the fact that the rubber material will be sufficiently tacky so that adjoining convolutions of the helical wind easily adhere along their edges.

The width of the tape must be great enough to require a minimum, economical number of convolutions in the winding operation; but must not be so wide as to be unhandy or produce steps across the face of the winding drum.

Tires were actually produced from fabric which had been made according to the invention by the use of tape comprising 10 parallel, side-by-side wire cords of .048" diameter spaced 14 to the inch, and embedded centrally in a rubbery insulation material to

give the tape a total thickness or gauge of about .070". The tape was thus about 10/14" wide and each cord could be said to be surrounded by substantially equal amounts of insulating rubber (about .011").

Fabric has also been successfully produced by using 12 wires spaced 16 to the inch, and 14 wires spaced 18 to the inch, and by using an overall tape thickness of .090".

Where 10 wires spaced 14 to the inch were used, the winding drum surface was 84" long and had a diameter of 24".

The tape used will preferably have a substantially flat surface, but a tape having a wavy (or shaped) surface, such as shown in Figure 2 may also be used.

Although, as stated above, a helical wind of a tape of some width is involved, the width of the tape, the pitch of the helix and the drum diameter are so chosen that a substantially flat sheet surface is produced on the member as the winding progresses under tension. Such tension at the drum may be provided through suitable torque-drive means at the drum.

After a sufficient amount of tape has been wound, it is severed from its supply; alternatively, a programmed length of tape, sufficient to form the entire envelope, may be supplied. The fabric envelope is cut lengthwise of the winding member. This cut may extend substantially parallel to the axis of rotation of the member or at some angle thereto depending on the bias-angle required at the tire building drum. When the cut fabric is removed from the winding member, opened into flat sheet form and turned, it will be noted that the cut edges of the fabric will now form the longitudinally extending sides of the new finished ply material, with each helix of the tape producing a transverse segment of the sheet. If cut along a line substantially parallel to the axis of rotation of the member, and joined to other similar sections, the new fabric sheet will have the cords extending at right angles to the sides of the sheet. If the cut is made at an angle to the axis of rotation, the turned and joined sections will exhibit cords extending at an angle to the sides of the new fabric sheet; this is bias-cut fabric.

In order to correct for the slight angle produced by the helical wind, an adjustment is made in the cutting angle. Let it be assumed, for example, that it is desired to make a cut which would result in cords extending at right angles to the sides of the turned fabric section. If the pitch of the helix is such as to produce a certain angle with the vertical, the cut along the winding member must also be adjusted to the same angle from the horizontal. This adjustment will, of course, be made to every cutting angle.

The tape winding can be so programmed that the starting and finishing ends of the tape will line up along the line to be cut. The tape may, of course, be wound with the ends extending above and below the cutting line in both directions, in which case these small extensions can readily be removed after cutting, to leave smooth edges.

Once cut, the fabric section is, as stated above, turned and may, if desired, be spliced to other sections similarly produced to form an endless web which can be wound in liners and brought to the tire building station.

It will be appreciated that the width of the convoluted tape sheet on the winding member may be so designed that the length of the cut edge will be exactly equal to the required length of the ply fabric required on the tire building drum. In this case, each wound section, when cut and turned, will of itself form a single ply for the tire.

Where necessary, the winding of the tape on the member may be followed by a stitching operation to further secure the edges of the convoluted tape together into a continuous sheet.

Instead of cutting the fabric envelope on the winding member, it is possible, of course, to remove the wound sheet as a unit by collapsing the winding member and thereafter cutting he fabric envelope at a separate location.

Turning now to the drawings, there is shown at 1 in Figure 1, a tape as preferably utilized in the present invention, and comprising generally longitudinally extending cords 2 embedded in a rubbery, unvulcanized compound 3. Figure 2 shows another, shaped, form of the tape 4, comprising cords 5 enveloped by compound 6. As has been stated above, both configurations of tape may be produced by the calendering method; preferably, however, the tape is produced by extrusion as, for example, shown in Figure 3.

Figure 3 shows a number of let-off creels 7 from which are drawn wires or cords 2. Alignment guides 13 and 14 space the cords 2 evenly for passage through the die 15 of an extruder 16, from which the cords emerge embedded in a rubbery compound as a substantially flat tape 1. The extruded tape passes over a series of tension rolls 17 and between a pair of spaced guide rollers 18 and thence is guided and applied in wound fashion to the winding member.

The modification shown comprises as a winding member a cylindrical drum 19 carried for rotation on a shaft 23. A motor 24 which maintains the tape in tension while it is being wound, provides rotating motion to shaft 23 and drum 19 through a gear reducer 25 and gears 26 and 27. The motor 24 simultaneously provides power through the gear reducer 25 and gears 28, 32 to a forward-reverse coupling box 33 engaging a driving screw 34.

Screw 34 extends parallel to the shaft 23 carrying drum 19 and is held against displacement in bearings 35, 36.

A winding carriage 37 is carried on driving screw 34 for longitudinal travel thereon.

Mounted at the rear of the carriage 37 is a pair of spaced guide rollers 38. Near the forward end of carriage 37 and in close proximity to the drum 19 is located an applicator roller 43 whose axis lies substantially parallel to the shaft 23 of the drum 19. Directly behind the roller 43 are two alignment rollers 44 which prevent the tape from being displaced laterally off the applicator roller 43.

Stop members 46 and 47, near the respective ends of the drive screw 34, are connected through suitable devices, not shown, so as to interrupt the lengthwise travel of the winding carriage 37 when contacted by it.

The winding operation of the tape 1 proceeds as follows: with the winding carriage 37 in position near the end of the winding drum 19 (Figure 5), the tape end 48 is led between guide rolls 18, to the winding carriage 37. The tape 1 is passed between guide rolls 38. It will be seen that the portion of the tape between the two sets of guide rolls 18 and 38, has been turned 90°, so that it " stands on edge ". Across this span, the parallel wires thus lie in a vertical plane, making it possible to move the tape laterally back and forth with respect to the stationary rolls 18. At the rolls 38, the tape is again turned to its original position, and enters between alignment rolls 44 (see Figure 5). The tape passes under applicator roller 43 and is by pressed with its flat side against the drum 19.

The drum 19 is rotated in a direction so that the tape end 48 proceeds up and over with the drum surface. Due to the coupling of both winding drum 19 and screw 34 to the same driving source, the winding carriage 37 proceeds along the face of the drum 19 while the drum rotates, to lay the tape 1 on the surface thereof.

As set forth above, the advance of the carriage 37, the speed of rotation of drum 19, and the width of the tape 1 are so chosen that a helical wind 52 (Figure 6) is produced on the drum, with the side edges of the tape firmly abutted, thus forming a continuous, cylindrical fabric envelope 53. A pressing device, such as a stitcher 54 may be utilized to assure firm edge-to-edge bonding of the tape convolutions. At the end of the carriage traverse, the carriage is stopped, and the tape severed, as at 55.

The drum may now be collapsed, to facilitate removal of the envelope 53 for purposes of opening the envelope; or the envelope may be cut open on the drum by, for example, a traversing knife device 56.

In order to correct for the angle x_1 produced by the pitch of the helical winding (see Figure 7), the cut b is made incorporating a correction x_2.

In the modification shown in Figure 6, it is intended to produce a cut b which is substantially normal to the edges a, a of the envelope 53. Therefore, the correction x_2 between the cut b and the horizontal axis 57 of the envelope 53 is made to correspond to the helix deviation x_1.

Similar corrections are, of course, made where the finished cut is to extend at some other angle with respect to the edges a, a.

Such a case is illustrated in Figure 8. After the envelope 53 has been cut as in Figure 8, it is opened into the trapezoidal sheet form shown in Figure 9. In Figure 10, the trapezoidal sheet 58 has been turned and one edge a thereof joined to a similar edge a of another sheet 58 to form a longitudinally extending web 60, in which cords extend at an angle to the edges b, b. This is bias-cut rubberized fabric ready for the tire-building process.

Where the nature of the finished ply requires, the winding operation may be preceded by placing a thin sheet of unvulcanized rubbery material 40 on the winding member, as shown in Figure 11, which acts as a winding base and aids in preventing the convoluted tape, once wound, from separating laterally when the finished ply is removed from the member and provides additional gauge. In some cases, also, it may be desirable to finish the winding operation by placing a covering sheet of rubbery material 42 on top of the wound fabric, to provide further stability and insulation.

WHAT WE CLAIM IS:—

1. A method of producing tire fabric, which comprises enclosing a plurality of cords in a rubbery compound, forming said cords and compound into a longitudinally extending tape, winding said tape helically into a fabric envelope, and opening said envelope along a line extending at an angle to said cords to form a trapezoidal sheet.

2. A method according to claim 1, wherein said cords in said tape are arranged in parallel, side-by-side relationship within said compound.

3. A method according to claim 1 or 2, wherein said tape is wound under tension.

4. A method according to any one of claims 1 to 3, wherein the first-mentioned steps of enclosing the cords and forming the tape include extruding said tape through a die.

5. A method according to any one of the preceding claims, which includes pressing the edges of said tape together after the winding step.

6. A method according to any one of the preceding claims, which includes joining one end of said trapezoidal sheet to another such sheet with their cut edges in alignment.

7. A method according to any one of the preceding claims, which includes providing a rubbery winding base prior to said winding step.

8. A method according to any one of the preceding claims, which includes providing a rubbery covering on said fabric envelope after said winding step.

9. A method according to any one of the preceding claims, wherein the tape is wound on a rotating winding member.

10. Apparatus for producing tire fabric, which comprises means for aligning a plurality of cords in parallel relationship, means to draw said aligned cords through a rubber extruder into rubberized tape form, characterized by a rotatable winding member, a winding carriage adapted for travel parallel to the axis of rotation of said member, applicator means on said carriage to lay said tape on said member, and means for rotating said member and for advancing said carriage in timed relationship to produce a helical wind of said tape on said member.

11. A method of producing tire fabric, substantially as hereinbefore described with reference to the accompanying drawings.

12. Apparatus for producing tire fabric, substantially as hereinbefore described with reference to the accompanying drawings.

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& ROLLINSON,
Chartered Patent Agents,
Agents for the Applicants.

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960488 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

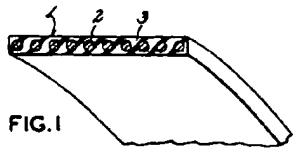

FIG.1

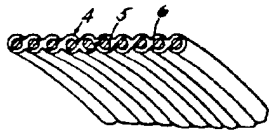

FIG.2

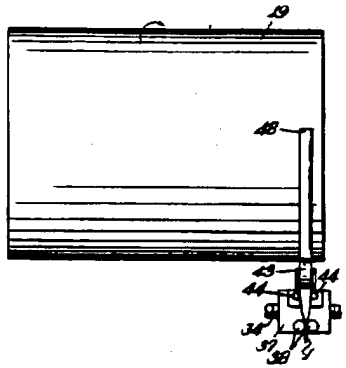

FIG.5

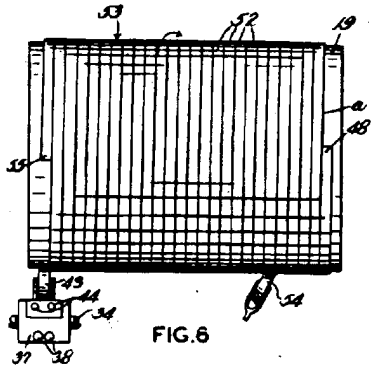

FIG.6

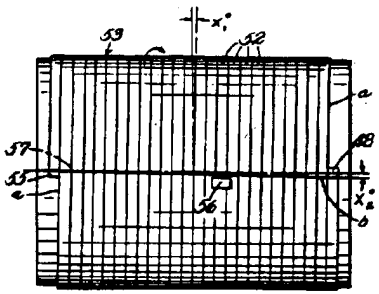

FIG. 7

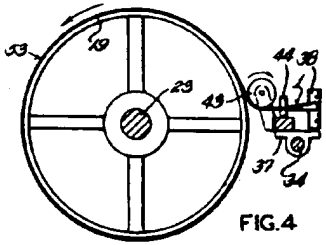

FIG.4

960488 COMPLETE SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 2

FIG.3

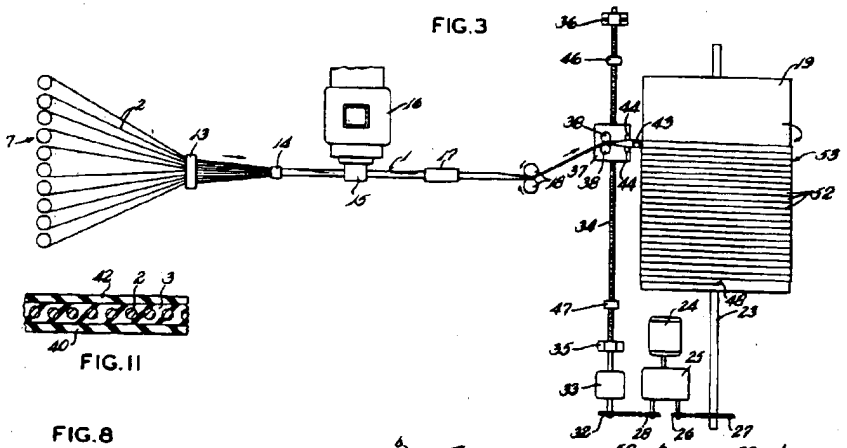

FIG.11

FIG.8

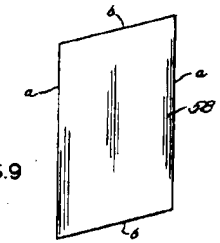

FIG.9

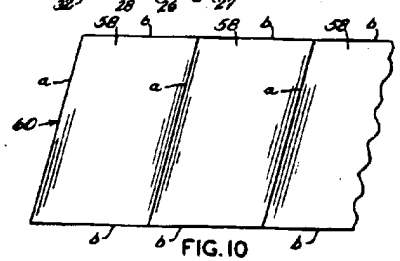

FIG.10